

What is claimed is:

1. A biomolecule capture device comprising:

(a) a substrate having a surface;

5 (b) a maleic anhydride biomolecule-binding compound covalently bound to the surface of the substrate, the maleic anhydride biomolecule-binding compound having a half life of binding of desired biomolecules of less than 1 hour; and a half life of release of desired biomolecules of less than 1 hour.

2. The biomolecule capture device of claim 1, the substrate comprising a polymer having exposed reactive sites on the surface.

10 3. The biomolecule capture device of claim 2, the substrate comprising one or more of polyamide, polyacrylamide, polyester, polycarbonate, polyethylene oxide, hydroxypropylmethylcellulose, polyvinylchloride, polymethylacrylate, polystyrene and copolymers of polystyrene, polyvinyl alcohol, polyacrylic acid, collagen, dextran, cellulose, calcium alginate, latex, polysulfone, agarose, aminohexyl agarose, 15 aminododecyl agarose, and glass.

4. The biomolecule capture device of claim 2, the substrate comprising aminohexyl agarose or aminododecyl agarose.

5. The biomolecule capture device of claim 1, the maleic anhydride biomolecule-binding compound comprising a dialkyl maleic anhydride.

20 6. The biomolecule capture device of claim 1, the maleic anhydride biomolecule-binding compound comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride.

7. The biomolecule capture device of claim 1, comprising a solid support.

25 8. The biomolecule capture device of claim 1, the desired biomolecule comprising an amine containing compound.

9. The biomolecule capture device of claim 8, the amine containing compound comprising a protein.

10. A method of removing and recovering desired biomolecules from a solution comprising the steps of

(a) contacting, under basic conditions, a solution containing one or more desired biomolecules with a biomolecule capture device comprising a substrate having a surface and one or more maleic anhydride biomolecule-binding compounds covalently bound to the surface of the substrate;

5 (b) forming one or more reversible covalent bonds between the biomolecules and the biomolecule-binding compounds, wherein the half life of binding between the biomolecule-binding compounds and the desired biomolecules is less than 1 hour;

10 (c) washing the biomolecule capture device and biomolecules attached thereto to remove unwanted biomolecules;

(d) exposing the biomolecule capture device to acidic conditions, thereby reversing the covalent bond between the biomolecules and biomolecule-binding compounds thereby releasing the biomolecules from the biomolecule capture device, 15 wherein the half life of release between the biomolecule-binding compounds and the desired biomolecules is less than 1 hour; and

(e) recovering the desired biomolecules.

11. The method of claim 10, the desired biomolecules comprising proteins.

12. The method of claim 10, the maleic anhydride biomolecule-binding compound 20 comprising a dialkyl maleic anhydride.

13. The method of claim 10, the maleic anhydride biomolecule-binding compound comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride.

14. The method of claim 10, wherein the half life of binding between the 25 biomolecule-binding compounds and the desired biomolecules is less than 30 minutes.

15. The method of claim 10, wherein the half life of release between the biomolecule-binding compounds and the desired biomolecules is less than 30 minutes.

16. The method of claim 10, the biomolecule capture device having a bead shape and is located in a column.

17. The method of claim 10, the desired biomolecule comprising an amine containing compound.

5 18. The method of claim 17, the amine containing compound comprising a protein.

19. A method of making a biomolecule capture device comprising:

(a) providing a substrate having one or more exposed reactive sites thereon;

(b) providing a dialkyl maleic anhydride;

(c) converting one alkyl group of the dialkyl maleic anhydride to a carboxyalkyl

10 group;

(d) converting the carboxyalkyl group into a N-hydroxysuccinimidyl ester;

(e) contacting the dialkyl maleic anhydride with the substrate having the exposed reactive sites; and

(f) forming a covalent bond between the substrate and dialkyl maleic anhydride.

15 20. The method of claim 19, the substrate comprising the form of a bead.

21. The method of claim 19, wherein the substrate is on a solid support.

22. The method of claim 19, the substrate comprising one or more of polyamide, polyacrylamide, polyester, polycarbonate, polyethylene oxide,

hydroxypropylmethylcellulose, polyvinylchloride, polymethylacrylate, polystyrene and

20 copolymers of polystyrene, polyvinyl alcohol, polyacrylic acid, collagen, dextran, cellulose, calcium alginate, latex, polysulfone, agarose, aminohexyl agarose, aminododecyl agarose, and glass.

23. The method of claim 19, the dialkyl maleic anhydride comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride.

25 24. A method of making a biomolecule capture device comprising:

(a) providing a substrate having one or more exposed amine reactive sites thereon;

(b) providing a dialkyl maleic anhydride having a N-hydroxysuccinimidyl ester at the 3 position and an alkyl group at the 2 position of the maleic anhydride;

(e) contacting the maleic anhydride with the substrate having the exposed amine reactive sites; and

5 (f) forming one or more covalent amide bonds between the substrate and maleic anhydride having a N-hydroxysuccinimidyl ester at the 3 position and an alkyl group at the 2 position of the maleic anhydride.

25. A biomolecule capture device comprising:

(a) a substrate having a surface;

10 (b) a dialkyl maleic anhydride biomolecule-binding compound covalently bound to the surface of the substrate.

26. The biomolecule capture device of claim 25, the substrate comprising aminohexyl agarose or aminododecyl agarose.

27. The biomolecule capture device of claim 25, the dialkyl maleic anhydride biomolecule-binding compound comprising dimethyl maleic anhydride, methyl ethyl maleic anhydride, or diethyl maleic anhydride.

28. The biomolecule capture device of claim 25, the substrate comprising a polymer having exposed reactive sites on the surface.

29. The biomolecule capture device of claim 25, the substrate comprising one or more of polyamide, polyacrylamide, polyester, polycarbonate, polyethylene oxide, hydroxypropylmethylcellulose, polyvinylchloride, polymethylacrylate, polystyrene and copolymers of polystyrene, polyvinyl alcohol, polyacrylic acid, collagen, dextran, cellulose, calcium alginate, latex, polysulfone, agarose, aminohexyl agarose, aminododecyl agarose, and glass.